

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

in re the Application of

Kazuyoshi TAMURA et al.

Group Art Unit: 1765

Application No.: 09/696,955

Examiner: M. A. Anderson

Filed: October 27, 2000

Docket No.: 107703

For: SILICON FOCUS RING AND METHOD FOR PRODUCING THE SAME

REQUEST FOR RECONSIDERATION

Director of the U.S. Patent and Trademark Office
Washington, D.C. 20231

Sir:

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In reply to the Office Action mailed January 30, 2002, reconsideration of the rejection and objections is respectfully requested in light of the following remarks.

I. Formal Matters

The drawings are objected to as being informal. Formal drawings will be filed after Notice of Allowance. See MPEP §608.02(b).

The above-identified application claims a foreign priority date of November 9, 1999 under 35 U.S.C. §119 based on Japanese Patent Application 11-317962. The Examiner is requested to acknowledge receipt of the certified copy of the priority document. Further, to perfect the priority claim, a certified translation of the priority document is attached. See MPEP §201.14.

In addition, the Examiner is requested to acknowledge his consideration of the Information Disclosure Statement filed with the application on October 27, 2000. Return of initialed PTO-1449 is requested.

II. Pending Claims 1-6 Define Patentable Subject Matter

The Office Action rejects claims 1-6 under 35 U.S.C. §103(a) as being unpatentable over Ke *et al.* (U.S. Patent 6,284,093) in view of Wolf *et al.* (*Silicon Processing for the VLSI*

Era, v. 1, pp. 8, 23, 27, 32-33, 59) and Tamatsuka *et al.* (U.S. Patent 6,299,982). This rejection is respectfully traversed.

Claim 1 of the present invention provides a silicon focus ring for a plasma apparatus consisting of silicon single crystal having concentration of interstitial oxygen not less than 5×10^{17} atoms/cm³ and not more than 1.5×10^{18} atoms/cm³ contained therein. A silicon focus ring, as claimed, reduces impurities from heavy metals to itself and to a wafer being processed during plasma etching. Thus, the fabrication yield of semiconductor devices can be improved. (See page 4 lines 2-6 and page 6 line 22 to page 7 line 3 of the specification.)

Claim 5 of the present invention provides a method for producing a silicon focus ring, grown by a Czochralski method into a single crystal having concentration of interstitial oxygen not less than 5×10^{17} atoms/cm³ and not more than 1.5×10^{18} atoms/cm³ contained therein. The method, as claimed, yields a silicon focus ring having sufficient gettering effect to improve focus ring longevity. The resulting silicon focus ring with specified interstitial oxygen therein thus reduces heavy metal impurities from plasma etching of a wafer.

Ke does not disclose or suggest a silicon focus ring having concentration of interstitial oxygen not less than 5×10^{17} atoms/cm³ and not more than 1.5×10^{18} atoms/cm³. Rather, Ke teaches a protective ring that "preferably is composed of pure silicon", thus teaching away from the present invention regarding oxygen concentration. See column 6 lines 31-32 of Ke.

Additionally, Ke provides no motivation for improvements as recited in the claims for the specified concentration of interstitial oxygen contained in a silicon focus ring. There is no motivation to do so because Ke has no recognition of the advantages of reducing heavy metal impurities during plasma etching. Moreover, Ke contains neither a description on improving the strength of a silicon focus ring by oxygen doping nor of the necessity of improving its strength.

Wolf does not disclose or suggest a silicon focus ring having concentration of interstitial oxygen not less than 5×10^{17} atoms/cm³ and not more than 1.5×10^{18} atoms/cm³.

Rather, Wolf teaches wafer processing, including slicing, etching and polishing. While Wolf describes that oxygen doping is known to increase a usual silicon wafer mechanical strength, there is no description provided on fabricating a focus ring from silicon and no motivation for including such techniques. See page 32 of Wolf. Also, as admitted in the Office Action, Wolf does not specify a ring with certain atomic concentration of oxygen to increase its strength.

Tamatsuka also does not disclose or suggest a silicon focus ring having concentration of interstitial oxygen not less than 5×10^{17} atoms/cm³ and not more than 1.5×10^{18} atoms/cm³. Rather, Tamatsuka describes a silicon single crystal wafer for fabrication of a semiconductor device, with no relation to a silicon focus ring. See col. 1 lines 16-18 of Tamatsuka. Tamatsuka teaches a wafer with nitrogen concentration between 0.2 and 5×10^{15} atoms/cm³ by controlled cooling during wafer fabrication to reduce crystal defects. See col. 4 lines 49-52 of Tamatsuka. Furthermore, while Tamatsuka mentions an oxygen concentration of 1×10^{18} atoms/cm³, the cited value represents a preferred upper limit to suppress crystal defect formation in the wafer. See col. 2 lines 47-51 of Tamatsuka. Additionally, there is no motivation to improve the gettering effect for benefit in a silicon focus ring.

As mentioned above, none of the cited references (Ke, Wolf and Tamatsuka) teaches or provides motivation for a silicon focus ring having concentration of interstitial oxygen not less than 5×10^{17} atoms/cm³ and not more than 1.5×10^{18} atoms/cm³. The functional and fabrication distinctions between a focus ring of silicon and an oxygen doped wafer demonstrate a lack of motivation to combine the structure and method disclosed in Ke with the methods described in Wolf and Tamatsuka. Because Ke, Wolf and Tamatsuka have no relation to each other in context to an oxygen doped silicon focus ring as claimed, there is no motivation to combine these references.

None of the references recognizes or addresses the combination of the claimed features, nor provides any motivation for their provision. Based on the above arguments, Applicants assert that the claims are now in condition for allowance.

Based on the above arguments, independent claims 1 and 5 of the present invention can not be properly rejected under 35 U.S.C. §103, and therefore are now in condition for allowance. Additionally, claims 2-4 and claim 6 depending from these claims respectively should be allowed by the same reasons above plus for the additional features they recite. Accordingly, Applicants respectfully request withdrawal of the rejections of claims 1-6.

III. Conclusion

In view of the foregoing remarks, the Applicants respectfully submit that this application is in condition for allowance. The Applicants, therefore, earnestly solicit favorable consideration and prompt allowance of this application.

Should the Examiner believe that anything further is desirable in order to place this application in better condition for allowance, the Examiner is requested to contact the Applicants' representative at the telephone number listed below.

Respectfully submitted,



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Attachment:
Certified Translation

Date: April 30, 2002

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